

**ELECTROFISHING
OPERATIONAL AND SAFETY
GUIDELINES**

North Carolina Wildlife Resources Commission

Division of Inland Fisheries

Raleigh, North Carolina

1999

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INTRODUCTION

Electrofishing is a commonly used sampling method employed by the North Carolina Wildlife Resources Commission (NCWRC). Electrofishing is a hazardous activity and faulty equipment or operation can result in serious injury or death. The objective of these guidelines is to ensure safe use of electrofishers through proper equipment design and operating procedures. It is the policy of the NCWRC that employees utilize these specifications and guidelines during all electrofishing operations.

These guidelines are based, in part, on the U.S. Fish and Wildlife Service Atlanta Regional Release 24-16 (1980), National Conservation Training Center Course: *Principles and Techniques of Electrofishing*, and *Electrofishing Guidelines and Procedures* (Ontario Ministry of Natural Resources, 1986). Appreciation is extended to Alan Temple of the U.S. Fish and Wildlife Service, National Conservation Training Center for his review of these guidelines and providing information on testing generators.

ELECTROFISHING EQUIPMENT

ELECTROFISHING BOATS

DESIGN

Electrofishing boats must be designed to provide adequate flotation and freeboard clearance consistent with equipment, cargo, and passenger weight when being operated. The boat will be equipped with a fire extinguisher, personal flotation devices (PFD), navigational lights, and audible signaling devices to meet NCWRC and U.S. Coast Guard regulations.

Safety rails (cage) will be provided around the bow of the boat, enclosing the netting area. Rails will be a minimum of 36" high and constructed of 3/4" diameter steel pipe, 1" diameter aluminum alloy pipe, or 1" diameter electrical metal tubing (EMT). Work decks will be covered with a non-skid material. Electrical equipment specifications not listed below are included in Appendix I.

CENTRAL CONTROLS

The operator must be able to operate all controls from one location and be able to quickly cut the power in case of an accident.

FOOT SAFETY SWITCHES

One netter and the boat operator will each be provided with a foot safety switch ("deadman" switch) electrically connected in a series and requiring positive pressure (as being depressed) by both persons to activate the main power circuit between the pulsator or generator and the electrodes.

GROUNDING AND BONDING

All metal surfaces including gas tanks, generators (see Appendix I), pulsators, tool boxes, and fish tanks within an aluminum-hulled boat will be electrically connected (grounded) to the boat hull to eliminate differences in electrical potential. It is recommended that any object that generates a charge (generator and pulsator) be grounded by hardwiring to the metal hull. This is accomplished by attaching a length of 12-gauge insulated wire between the object and the hull using wire terminals and sheet metal screws or bolts. Other objects such as gas tanks, fish tanks, and toolboxes may be passively connected to the using alligator clips. Connections must to be made between bare metal. A multimeter will be used to test the connection between all metal surfaces and the hull to assure grounding (Appendix I.G). It is recommended that plastic gas tanks and boxes are used which eliminates the need for grounding.

ELECTRODES

An aluminum boat hull may be used as a cathode for D.C. electrofishing. The anode must be electrically insulated from the hull when the hull is used as the cathode. Electrodes will also be insulated from their respective booms.

AUXILIARY LIGHTS

Lighting and other auxiliary circuits should not exceed 24 volts. Lamps (110V) may be used provided the lamp is adequately shielded within a cage.

DIP NETS

Net handles are to be constructed of a nonconductive material. Fiberglass handles are preferred however, wooden handles covered with thin-walled PVC pipe may be used. Wrapped or covered metal handles will not be used.

BATTERY ENCLOSURE

An acid-proof, nonmetallic enclosure with adequate venting and holder will be provided for wet cell batteries.

EXHAUST

The generator will be positioned so that exhaust is not directed at the boat operator or will be piped away from the boat operator. All piping should be enclosed in protective screen or insulated to reduce the potential of personnel contacting hot pipes. Galvanized pipe will not be used for exhaust due to the potential toxic gases produced under extreme heating conditions.

FUEL STORAGE AND REFUELING

Gasoline will be stored and transported in approved safety containers. All equipment will be turned off and allowed to cool prior to refueling.

NOISE

Occupational Safety and Health Administration (OSHA) regulations specify maximum noise exposure (decibels) per hour per day. Prolonged exposure to noise at or above 90 db may cause hearing loss. Noise levels produced by a WRC electrofishing boat were previously tested and found to be nearly 90 db in proximity to the boat operator. Therefore, hearing protection must be worn (ear muffs or plugs) during electrofishing.

FIRE EXTINGUISHER

Each boat will be equipped with at least 1-2 1/2 lb. Type ABC or BC fire extinguisher mounted in a holder for easy access by the boat operator and away from high fire potential sources.

LIFE VESTS

All boat occupants will wear a Type I, II, or III U.S. Coast Guard approved personal flotation device (PFD) while electrofishing is being conducted or the boat is under power.

PORTABLE ELECTROFISHERS (Backpack and generator-powered bank and canoe units)

ELECTRODES

Electrode handles will be constructed of a nonconductive material and be long enough so that personnel do not directly contact the water. The positive electrode (anode) will be equipped with a hand-held safety switch that breaks the electric current upon release. The anode will not be used as a net to capture stunned fish. A foot safety switch (see below) is required for canoe-mounted generator units.

POWER CONTROL

The operator will have a switch to the pulsator or power control unit so that the electricity can be turned off quickly in an emergency. The operator must be able to operate all controls from one location. All backpack electrofishers will be equipped with a tilt switch that breaks the circuit if the operator falls. A manual reset-type switch is required, which on some backpack units is the safety switch on the electrode (anode) handle.

SAFETY SWITCHES

For backpack electrofishing, hand-held safety switches are required for the operator and each person using anode poles. All safety switches are to be connected in series. The anode/cathode control switches are to be insulated from the operator by a rubber boot. For canoe-mounted generator units, a foot safety switch is required to activate the power control circuit between the generator and electrodes.

FUEL STORAGE AND REFUELING

Gasoline will be stored and transported in approved safety containers. Containers will be kept at least 15 ft. away from the generator while in operation. All equipment will be turned off and allowed to cool prior to refueling.

BATTERIES

Batteries used as electrical power source for backpack shockers must be a sealed type to avoid acid spills. Gel type batteries are preferred.

BACKPACK FRAMES

Backpacks will be equipped with a quick release belt (hip) and shoulder straps.

GENERAL OPERATING PROCEDURES AND PERSONAL SAFETY EQUIPMENT

ELECTROFISHING CREW LEADER

One NCWRC employee will assume responsibility for each electrofishing operation. The principal investigator will generally assume the duty of crew leader. It is the duty of the crew leader to:

1. Identify hazardous conditions associated with proposed electrofishing and determine measures needed to protect crew members.
2. Brief all new crew members on safe operation of equipment and procedures before commencing.
3. Ensure that employees have and utilize proper safety equipment.
4. Provide warning and take action to assure that the public is not exposed to the potential hazards of electrofishing.
5. Ensure that precautions are taken to avoid harm to pets, domestic animals or wildlife.
6. Discontinue electrofishing operations during inclement weather and have all personnel leave the water in the event of an electrical storm.

PERSONAL SAFETY EQUIPMENT

INSULATED GLOVES

All personnel will wear rubber linesman's gloves that are rated above the voltage being used. Gloves will be inspected and electrical integrity checked annually and replaced when necessary. Leather shells or gloves of other material, will always be worn over insulated gloves to protect their integrity.

FOOTWEAR

Rubber boots at least shin high will be utilized while boat electrofishing. Hip boots or chest waders will be worn, as conditions dictate, when backpack electrofishing. Non-slip (felt) soles will be utilized when electrofishing in streams with rock substrates.

LIFE VESTS

All occupants of electrofishing boats or canoes utilizing generator type shockers will wear approved personal flotation devices (PFD-type I, II, or III) while electrofishing.

GLASSES

Polaroid-type sunglasses should be worn to reduce glare from the water and identify underwater features hazardous to navigation or wading.

HEARING PROTECTION

Ear plugs or muffs will be utilized as specified under Section I.A.11.

ELECTROFISHING BOATS - GENERAL OPERATING PROCEDURES

1. The crew leader will ensure that their duties as specified in Section II.A, are met and that all safety equipment (Section II.B) is utilized.
2. Pulsator will be turned off prior to starting the generator.
3. The generator will be turned off prior to making any hardware adjustments or repairs.
4. Personnel are never to reach into the water even if wearing rubber gloves.

PORTABLE ELECTROFISHERS - GENERAL OPERATING PROCEDURES

1. The crew leader will ensure that their duties, as specified in section II.A, are met and that all safety equipment (Section II.B) is utilized.
2. Backpack electrofishing will be conducted with a minimum of two persons.
3. Generator-type bank electrofishing will be conducted with a minimum of three persons. One of these will attend the electrofisher control box at all times during operation.
4. Electrofishing equipment will be turned on only after the operator has entered the stream and turned off prior leaving the stream.
5. Electrofishing units will be shut off prior to making any repairs.
6. Personnel are never to reach into the water in the vicinity of an electrode even if rubber gloves are worn.

NON-WRC PERSONNEL PARTICIPATION

Non-WRC personnel may participate in electrofishing activities only if they are briefed on safe operation of equipment and procedures before commencing. All participants are required to utilize prescribed safety equipment. Short, independent training sessions are strongly encouraged.

TRAINING

ELECTROFISHING

1. It is recommended that all crew leaders receive training in the fundamentals of electrofishing through the National Conservation Training Center* course or at a NCWRC training course.

*For more information: www.fws.gov/r9nctc/catalog/FIS2101.html
www.fws.gov/r9nctc/catalog/FIS2c01.html

or contact: Chief, Branch of Aquatic Resources Training
USFWS-NCTC
Route 1, Box 166
Shepherdstown, WV 25443
304.876.7445

2. All the crew must be briefed in the safe operation of equipment and procedures before electrofishing. The instruction should include a brief description of the design of the electrofisher, hazards involved, and identification of the safety features of the equipment. It is recommended that all new crew personnel participate in a practice run with the equipment prior to electrofishing.

FIRST AID

It is required that crew leaders and crew receive first aid and CPR training.

INSPECTION OF EQUIPMENT

Electrofishing equipment will be inspected by an employee designated by the Regional Supervisor. Inspections will usually occur prior at the beginning and end of the sampling season and after major modifications to the boat or electrofisher.

It is the responsibility of the crew leader to assure that all electrofishing and safety equipment, as detailed in Sections I and II, are present and utilized during all electrofishing sampling. Any deficiencies will be noted and corrected prior to sampling. An inspection list for electrofishing boats is presented in Appendix II and for portable shockers in Appendix III. The annual inspection is to be part of a regular maintenance program to boat motors, trailers and generators.

REFERENCES

- Goodchild, G.A. 1986. Manual of instructions, electrofishing guidelines and procedures. Ontario Ministry of Natural Resources, Fisheries Branch. Official Procedure Manual, Policy F1.3.01.01, 60pp.
- Goodchild, G.A. 1990. Electric fishing and safety. Pages 157-175, In I.G. Cowx and P. Lamarque (eds.), Fishing with Electricity, Fishing News Books, Blackwell Scientific Publications, Cambridge, MA.
- Kolz, A.L., J. Reynolds, A. Temple, J. Boardman, and D. Lam. 1998. Principles and techniques of electrofishing. U.S. Fish and Wildlife Service, National Conservation Training Center, Shepherdstown, WV.
- U.S. Fish and Wildlife Service. 1980. Electrofishing- electrical equipment specifications/ operations. Atlanta regional release 24-16.

APPENDIX

APPENDIX I. ELECTRICAL EQUIPMENT SPECIFICATIONS

GENERATORS

Certain modifications must be made to generators utilized for electrofishing with metal-hulled electrofishing boats. The generator case neutral must be removed or, less commonly, an isolation transformer installed between the generator and the pulsator. Generators provided by commercial companies specialized in electrofishing (Smith Root, Coffelt) usually have the case neutral removed. The equipment manual should be consulted to determine if an isolation transformer is present. Case neutral removal is difficult and should only be done by the generator dealer or a licensed electrician. ***Failure to make these modifications can result in injury to personnel or equipment.*** Without the case neutral removed, a 120-volt path can be set up from the generator through the pulsator to the boat hull or cathode into the water and returning from the hull to the generator windings. Consequences may include ***shock to persons in contact with the water***, generator “bog-down”, and equipment damage. **Note:** when the generator is running the shock hazard exists with the pulsator turned off.

It is preferred that all generators used for electrofishing have the case neutral removed. As it can be a problem having this done, it is recommended that electrofishing generators be purchased from electrofishing supply companies. If the case neutral cannot be disconnected or an isolation transformer provided, the generator must be “floated” from the hull. The generator can be floated by placing it on a wooden pallet which prevents it from coming in contact with the hull and thus breaks the electrical path between the generator and cathode. In this case, do not ground the generator to the hull and always handle the generator with insulated gloves.

Generators with case neutral removed also ***present a shock hazard when used on land*** as the generator windings are not grounded. Only tools with plastic housing should be used with these generators or rubber gloves worn if using tools with metal housings. Insulated gloves are to be used when handling modified generators on land.

To test the status of a generator’s case neutral, start the generator with the boat on land. ***Care must be taken during this test as touching the electrodes may result in serious shock.*** Questions on this section should be referred to Chief, Branch of Aquatic Resources Training, USFWS-NCTC (see page 10).

1. Park boat on a level area.
2. Clip negative multimeter lead to boat hull (cathode).
3. Clip positive multimeter lead to one boom electrode (anode). Repeat with the other boom electrode.
4. Start generator with pulsator turned off.
5. Read multimeter set to AC voltage.
6. Voltage present indicates intact generator case neutral.
7. Voltage absent indicates disconnected generator case neutral.

VOLTAGE

Rated voltages of insulations of conductor used to deliver output current from the pulsator to the electrodes must exceed the maximum potential voltage of the pulsator or generator by the next higher rating as follows:

| Pulsator /Generator | Minimum insulation rating of conductor |
|---------------------|--|
| 0-249 volts | 250 volts |
| 249-599 volts | 600 volts |
| 599-899 volts | 900 volts |
| 900-12,999 volts | 13,000 volts |

CONDUCTOR SIZE

Minimum conductor (current carrying wire) sizes will be approved for rated amperage of equipment as follows:

| Amperage | Conductor size |
|----------|----------------|
| 0-15 | 14 AWG |
| 16-20 | 12 AWG |
| 21-30 | 10 AWG |

CONDUCTOR TYPE

Conductors will be of the stranded type for flexibility and will meet requirements for dampness. All conductors in the boat will be enclosed in raceways or conduit except that appropriate heavy rubber cord can be used if greater flexibility in installation is desired.

CONNECTIONS

No splices of wire will be permitted. If connections are necessary, the rating of the connector must be the same or greater than the wire.

JUNCTION BOXES

Junction boxes will be cast iron, cast aluminum, fiberglass, plastic, or rubber. All types must either be weatherproof or raintight depending on use. All junction boxes with switching equipment must be weatherproof. Junction boxes without switches may be raintight.

USE OF MULTIMETER (VOLT-OHM)

To test continuity (grounding) between objects in a shocking boat and the hull, connect the positive (red) and negative (black) leads to the respective positive and negative outlets on the meter. The positive outlet is typically marked “+ V- Ω -A”. Set the meter to the highest ohm (Ω) reading (ex. RX10K). Attach one lead to the boat hull and the other to the object being tested; it doesn't matter which goes where. If the gauge reads zero there is no resistance between the boat hull and the object. If the gauge reads above zero, the object is not properly grounded for some reason. When this happens check to make sure the meter is calibrated to zero before starting by touching the two leads together and adjusting the gauge needle to zero. Resistance between the objects can also be caused by loose connections, painted surfaces, broken wires or rusted connectors.

APPENDIX II. ANNUAL INSPECTION LIST - ELECTROFISHING BOATS

BOAT

1. Hull integrity
2. Safety railing intact
3. Non-skid footing
4. Wiring meets specifications
5. All metal equipment in aluminum boats grounded to hull (check with volt/ohm meter)
6. Proper venting of exhaust
7. Batteries properly enclosed and vented (where applicable)
8. Regulation fuel containers
9. Anchor present

ELECTROFISHER

1. Controls and gauges operational
2. Wiring and connectors in satisfactory condition
3. Output voltage light working
4. All foot safety switches working
5. Emergency shutdown switch working

GENERATOR/ALTERNATOR

1. Unit mounted securely and grounded to hull
2. Exhaust directed away from operator
3. All electrical connective secure
4. Oil changed

AUXILIARY EQUIPMENT

1. Dip net handles are made of non-conductive material; netting repaired or replaced
2. Fire extinguisher present and charged
3. Rubber gloves and shells present and in good condition

APPENDIX III. ANNUAL INSPECTION LIST - PORTABLE ELECTROFISHERS

ELECTROFISHER

1. Controls and gauges operational
2. Wiring and connectors in satisfactory condition
3. Emergency shutdown switch working
4. Anode and tilt switch working (where applicable)
5. No screens or nets attached to anode
6. Sealed batteries in good condition
7. Backpack frame in good condition
8. Quick release mechanism on frame working

GENERATOR/ALTERNATOR (where applicable)

1. Wiring and connectors in satisfactory condition
2. Unit mounted securely to frame and frame properly grounded
3. Exhaust directed away from operator
4. Oil changed

AUXILLARY EQUIPMENT

1. Rubber gloves and shells present and in good condition
2. Dip net handles are made of non-conductive material; netting repaired or replaced
3. Regulation fuel containers (where applicable)